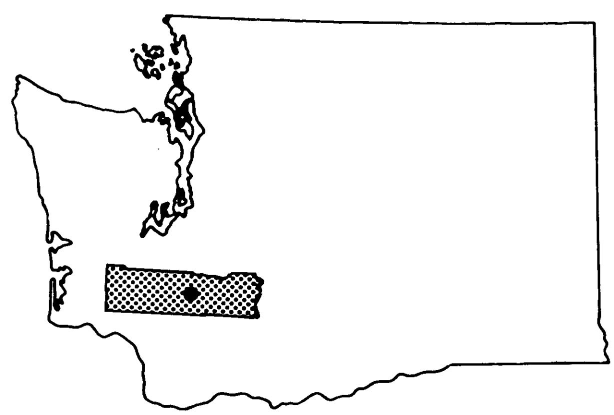
FLOOD INSURANCE STUDY

CITY OF MORTON, WASHINGTON

LEWIS COUNTY



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federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 530105

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Morton, Lewis County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Morton to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The identification of streams selected for detailed analysis was accomplished in a meeting held on April 14, 1976, and attended by representatives of the community, a study contractor formerly identified to perform the study but not subsequently brought under contract, and the Federal Insurance Administration. A meeting held on July 6, 1976, was attended by representatives of the county, the finally selected study contractor, and the Federal Insurance Administration.

During the course of the study, numerous informal contacts were made by the study contractor with the community for the purpose of obtaining data and acquiring base map material.

On May 26, 1978, the results of the work were reviewed at an Interim Technical Meeting attended by representatives of the study contractor, the Federal Insurance Administration, and the City of Morton.

The results of this study were reviewed at a final community coordination meeting held on September 20, 1978. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the city. No problems were raised at the meeting.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for the Federal Insurance Administration, under Contract No. H-4025. This work, which was completed in June 1978, covered all significant flooding sources affecting the City of Morton.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Morton, Lewis County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by the overflow of Tilton River and Lake Creek were studied in detail.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

2.2 Community Description

Morton is located in the geographic center of Lewis County, in southwest Washington, at the foot of Cutler Mountain on the edge of the Tilton River Valley, approximately 38 miles east of Chehalis. Morton lies east of Interstate Highway 5 on U.S. Highway 12, and on State Highway 508, which runs roughly parallel to and north of U.S. Highway 12 from Interstate Highway 5 to Morton where it joins State Highway 7, serving the city from the north.

Morton was first settled in 1891 and incorporated on June 6, 1913. Unlike many of the smaller municipalities in Lewis County, Morton experienced quite a rapid population growth from 475 in 1930 to over 1100 in 1950. Since then, the population has slowly increased to an estimated 1400 in 1977 (References 1 and 2). The economy of Morton, and Lewis County in general, depends heavily on the lumber, milling, and wood-products industry, which comprised three-fourths of the total manufacturing employment of the county in 1976. Agricultural and dairy farming are also carried on.

Morton has a mid-latitude, west coast marine-type climate, typified by dry, cool summers and mild, wet, and cloudy winters. The average annual precipitation is approximately 70 inches, with the bulk of this occurring from September to April. Minimum summertime temperatures range from the mid-thirties to the mid-fifties. The average annual snowfall is light, seldom remaining on the ground longer than 1 week or reaching a depth in excess of 8 to 12 inches (Reference 3).

Tilton River, together with its tributaries upstream of Morton, drains an area of approximately 71.5 square miles. Two significant tributaries to Tilton River are West Fork Tilton River, with headwaters in the steep, densely forested Snoqualmie National Forest to the north, and East Fork Tilton River, with headwaters in the high,

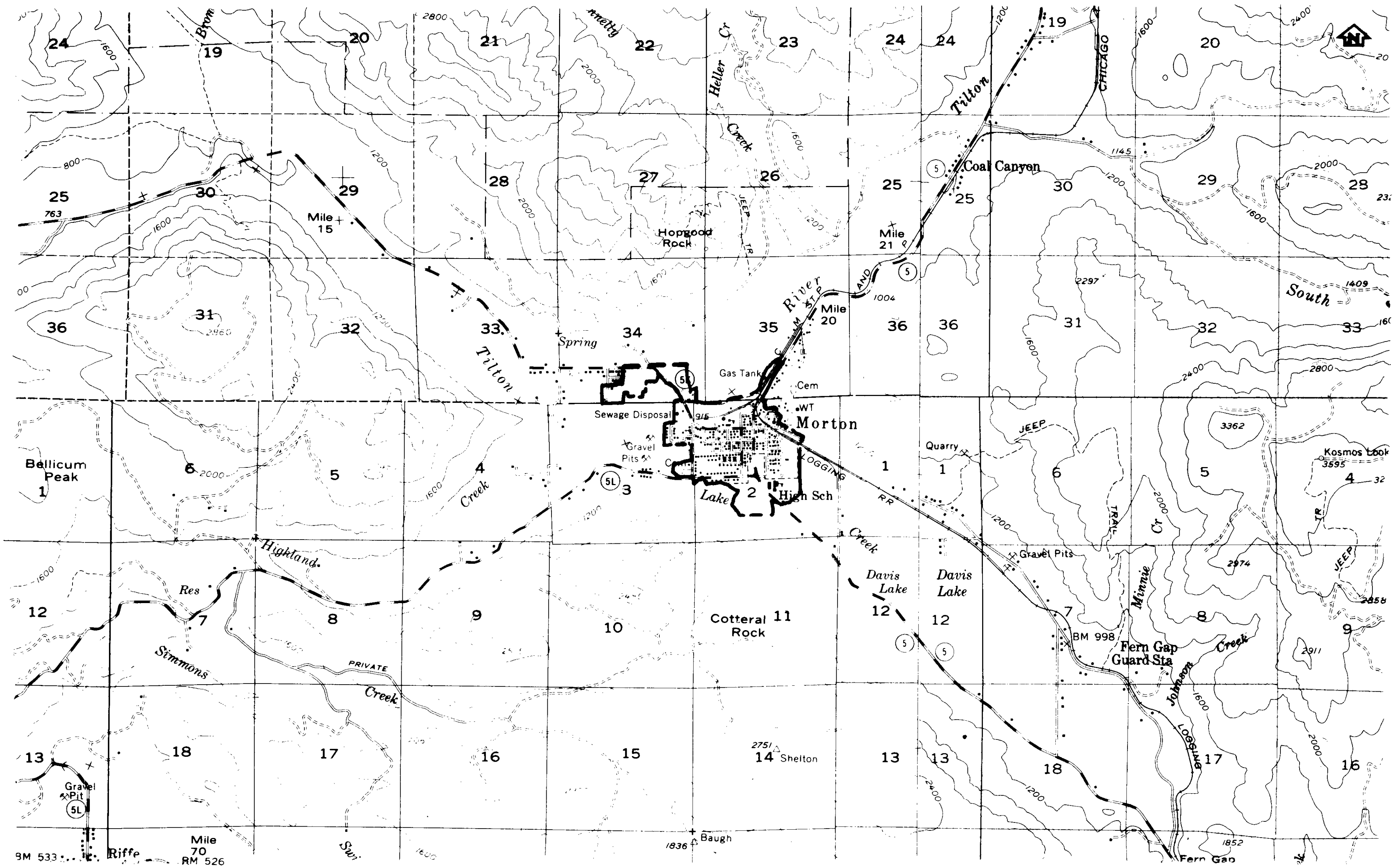

FIGURE 1	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration **CITY OF MORTON, WA** (LEWIS CO.)

APPROXIMATE SCALE

1 0 1 2 3 MILES

VICINITY MAP

rugged Gifford Pinchot National Forest to the northeast of Morton. Elevations within the basin range from approximately 900 feet at Morton to over 4500 feet at the headwaters. The streambed slope of the river through the City of Morton is approximately 34 feet per mile. Lake Creek and its tributaries upstream of Morton drain an area of approximately 11.7 square miles. The creek originates in Davis Lake, approximately 2 miles southeast of Morton, and flows westerly along the southern corporate limits to its confluence with the Tilton River downstream of Morton. The existing streambed slope averages approximately 35 feet per mile.

2.3 Principal Flood Problems

The major flood season in the Tilton River basin extends from late fall through the winter. There have been instances, however, when less significant floods occurred in the spring. Major floods usually result from a combination of intense rainfall and snowmelt when the ground is already saturated.

The largest known flood in the City of Morton occurred in December 1933. No records are available on Tilton River; however, the 1933 flood was considered to be approximately a 100-year flood in Cowlitz River basin. Other large floods occurred on Tilton River in December 1953, December 1955, November 1962, and January 1972. The peak discharge of the December 1955 flood was 23,200 cubic feet per second, measured at the Cinebar gaging station. That discharge approximates a 50-year flood.

Tilton River periodically overflows its banks through the study reach near Morton. A portion of the city, including some residential and industrial development, was inundated in January 1972. Also, during that flood, the swiftly moving water eroded several areas intended to be part of a city park.

There are no manmade obstructions in the study reach which would significantly impede the passage of floods. High flows are somewhat restricted at State Highway 508 bridge, primarily as a result of a confined natural floodway at that location. Debris jams also would retard floodflows, thus creating backwater and increased flood heights. However, it is impossible to predict the degree or location of such accumulations.

2.4 Flood Protection Measures

There are no existing or proposed flood-control storage projects to reduce flooding in the study reach. Some bank protection and channel work was accomplished following the January 1972 flood, in an attempt to stabilize the Tilton River channel. Channel improvement work was also carried out on Lake Creek through parts of the study reach.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Floodflow frequency data for Tilton River were based on statistical analyses of discharge records at the following streamflow gaging stations operated by the U.S. Geological Survey:

Stream and Gage	Location	Period of Record
Tilton River near Cinebar (No. 14236500)	Approximately 15 miles downstream from Morton	1941-1958
Tilton River above Bear Creek near Cinebar (No. 14236200)	Approximately 10.5 miles downstream from Morton	1956-current
West Fork Tilton River near Morton (No. 14235500)	4.5 miles upstream of Morton	1950-current

Analyses were performed in accordance with standard log-Pearson Type III methods as outlined by the U.S. Water Resources Council (Reference 4). Adjustments to compensate for the smaller drainage area upstream of Morton were made using the runoff-routing computer model described in the following paragraph.

No streamflow records are available for Lake Creek. Flood peaks for the design return floods were computed using rainfall-runoff relationships developed for the area and a computerized storm water routing model. The model incorporates the unit hydrograph criteria developed by the U.S. Soil Conservation Service (Reference 5).

The 24-hour duration storm precipitation volumes for 10-, 50-, and 100-year return storm frequencies were obtained from the National Oceanic and Atmospheric Administration Atlas 2 (Reference 6). Precipitation volume for the 500-year storm was obtained by extending the National Oceanic and Atmospheric Administration Atlas 2 frequency curve on normal distribution probability paper. The intensity of distribution was based on Cinebar rainfall gage records.

Peak discharge-drainage area relationships for Tilton River and Lake Creek are shown in Table 1.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second)			
		10-Year	50-Year	100-Year	500-Year
Tilton River					
At Confluence With Lake Creek	85.9	11,100	14,720	17,100	21,000
At Confluence With Connelly Creek	71.5	10,190	13,550	15,560	19,320
Lake Creek					
At Confluence With Tilton River	11.7	1,090	1,340	1,530	1,720

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Water-surface elevations were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 7). Aerial photographs, contour maps, and cross-section data were provided by Towill, Inc., San Francisco, California, under subcontract to the Study Contractor (Reference 8). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Channel and overbank roughness factors (Manning's "n") were based on field inspection and photographs at each cross-section location. Values varied from channel roughness coefficients of from 0.040 to 0.055 to an overbank coefficient of 0.200.

Starting water-surface elevations for the study reaches were computed by the slope-area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of 4 feet (Reference 8). Additional flood boundary and topographic adjustments were made along Lake Creek, using a U.S. Geological Survey (USGS), 7.5-Minute Series Orthophotoquad, Scale 1:24,000, Morton, S.E., Washington, 1979 (Reference 9).

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood Boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map.

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the FIA limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways developed in this study were computed on the basis of equal conveyance reduction from each side of the flood plain.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and the 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE (FEET)
TILTON RIVER								
A	17.08	186[2]	2055	8.3	887.7	887.7	888.4	0.7
B	17.34	158[2]	1291	12.3	893.3	893.3	894.0	0.7
C	17.68	109	1226	12.9	906.6	906.6	907.6	1.0
D	17.70	156	1056	15.0	910.7	910.7	910.7	0.0
E	17.86	655/185[3]	5114	3.1	918.0	918.0	918.4	0.4
F	18.16	121[2]	1017	15.3	922.8	922.8	923.3	0.5
G	18.41	460[2]	3615	4.3	938.5	938.5	938.8	0.3
LAKE CREEK								
A	1.29	56[2]	510	3.0	934.6	934.6	934.8	0.2
B	1.37	40[2]	385	4.0	935.0	935.0	935.3	0.3
C	1.39	37[2]	316	4.8	935.1	935.1	935.5	0.4

[1]Miles Above Mouth
[2]Floodway Lies Entirely Outside Corporate Limits
[3]Width/Width Within Corporate Limits

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FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MORTON, WA
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FLOODWAY DATA

TILTON RIVER - LAKE CREEK

TABLE 2

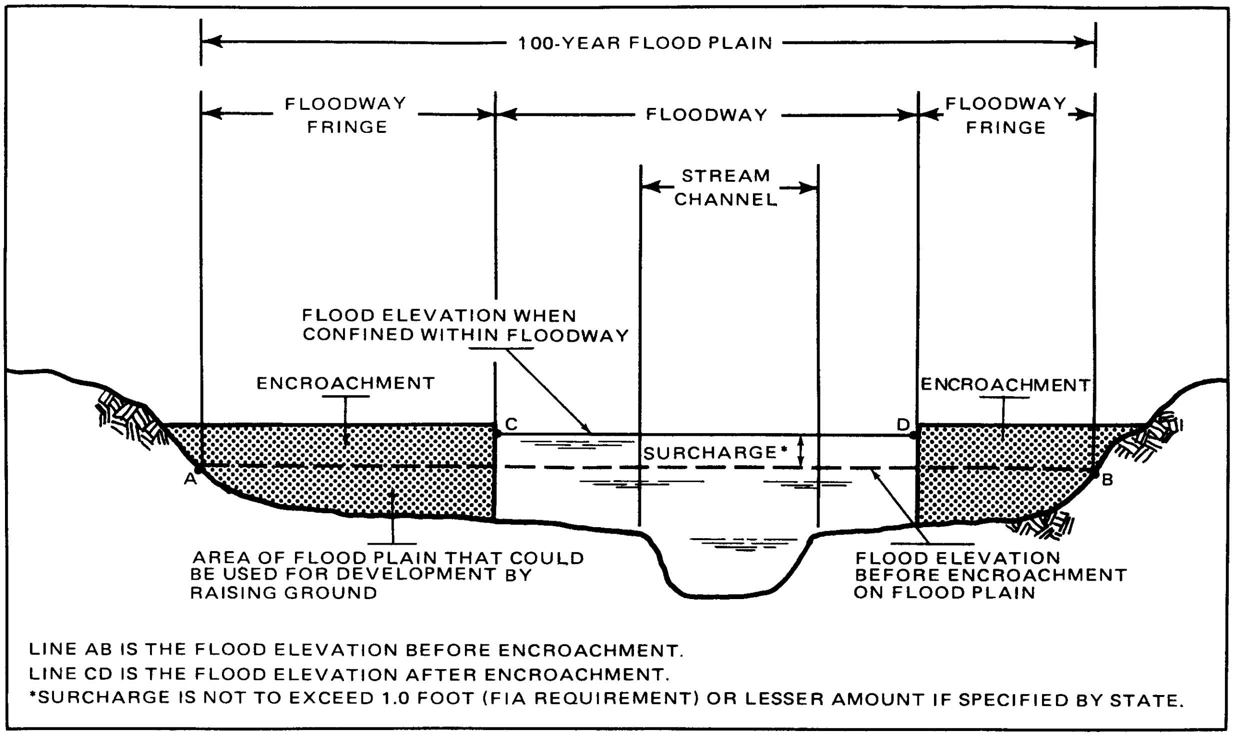

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Morton.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Two reaches meeting the above criteria were required for the flooding sources of Morton. These included one each on Tilton River and Lake Creek. The locations of the reaches are shown on the Flood Profiles.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the FIA device used to correlate information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Morton was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A3 and A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water-control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Morton is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The U.S. Army Corps of Engineers, Portland District, published a Special Flood Hazard Information Report for the Tilton River through the City of Morton, Washington, in February, 1973 (Reference 10). The results presented in this study reflect an updated hydrologic analyses incorporating additional available streamflow data and topographic conditions adjusted from a U.S. Geological Survey, 7.5-Minute Series Orthophotoquad, Scale 1:24,000, Morton, S.E., Washington, 1979 (Reference 9).

This study is in general agreement with the FIA's Flood Hazard Boundary Map for the City of Morton (Reference 11).

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Director, Insurance and Mitigation Division, Federal Emergency Management Agency, Federal Regional Center, 130 228th Street, S.W., Bothell, Washington 98011.

8.0 BIBLIOGRAPHY AND REFERENCES

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Tilton River Reach 1	0001	-2.3	-0.8	1.3	025	A5	Varies - See Map
Lake Creek Reach 1	0001	-1.7	-0.7	0.6	015	A3	Varies - See Map

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MORTON, WA
(LEWIS CO.)

FLOOD INSURANCE ZONE DATA

TILTON RIVER-LAKE CREEK

TABLE 3

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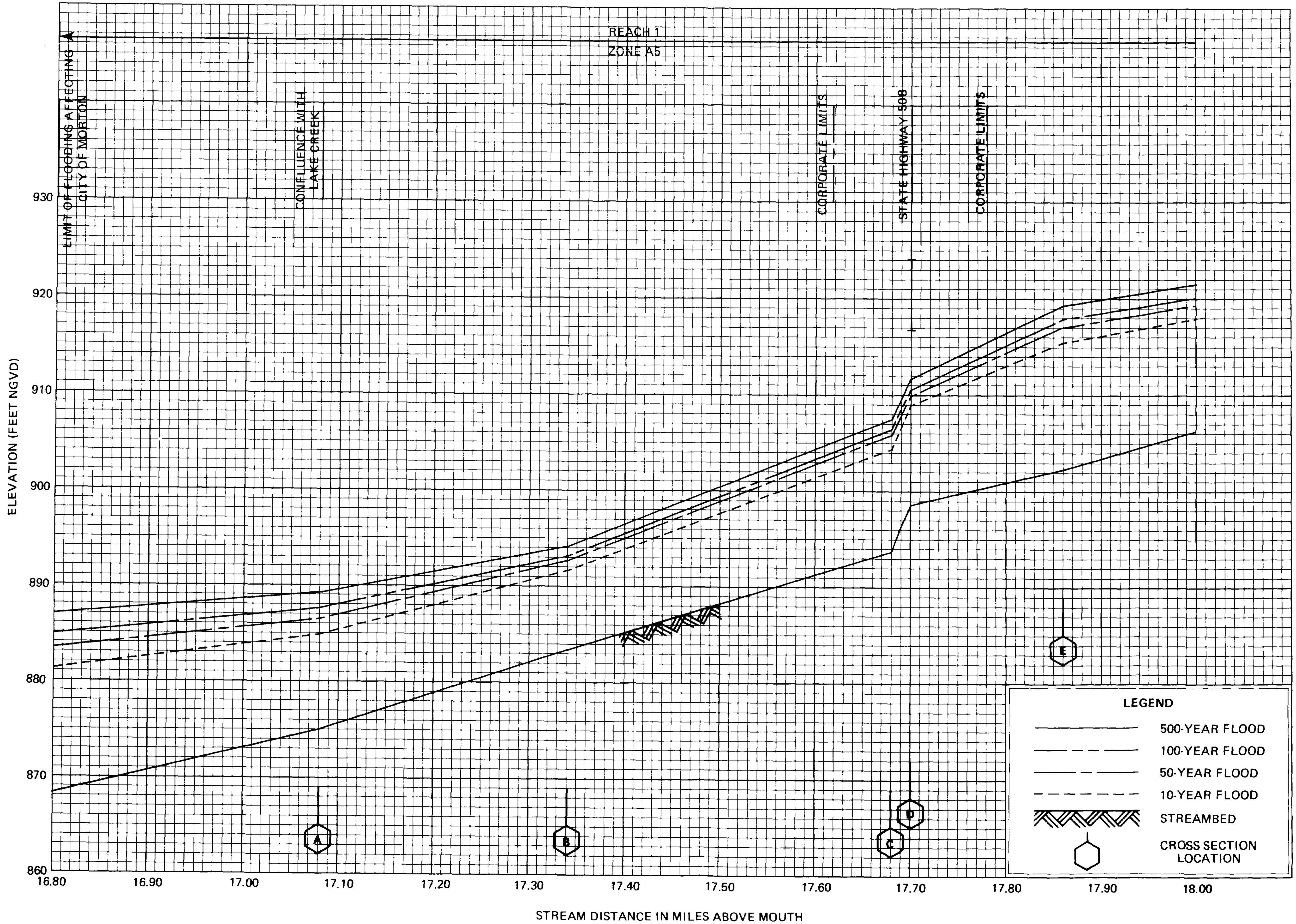

FLOOD PROFILES

TILTON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MORTON, WA
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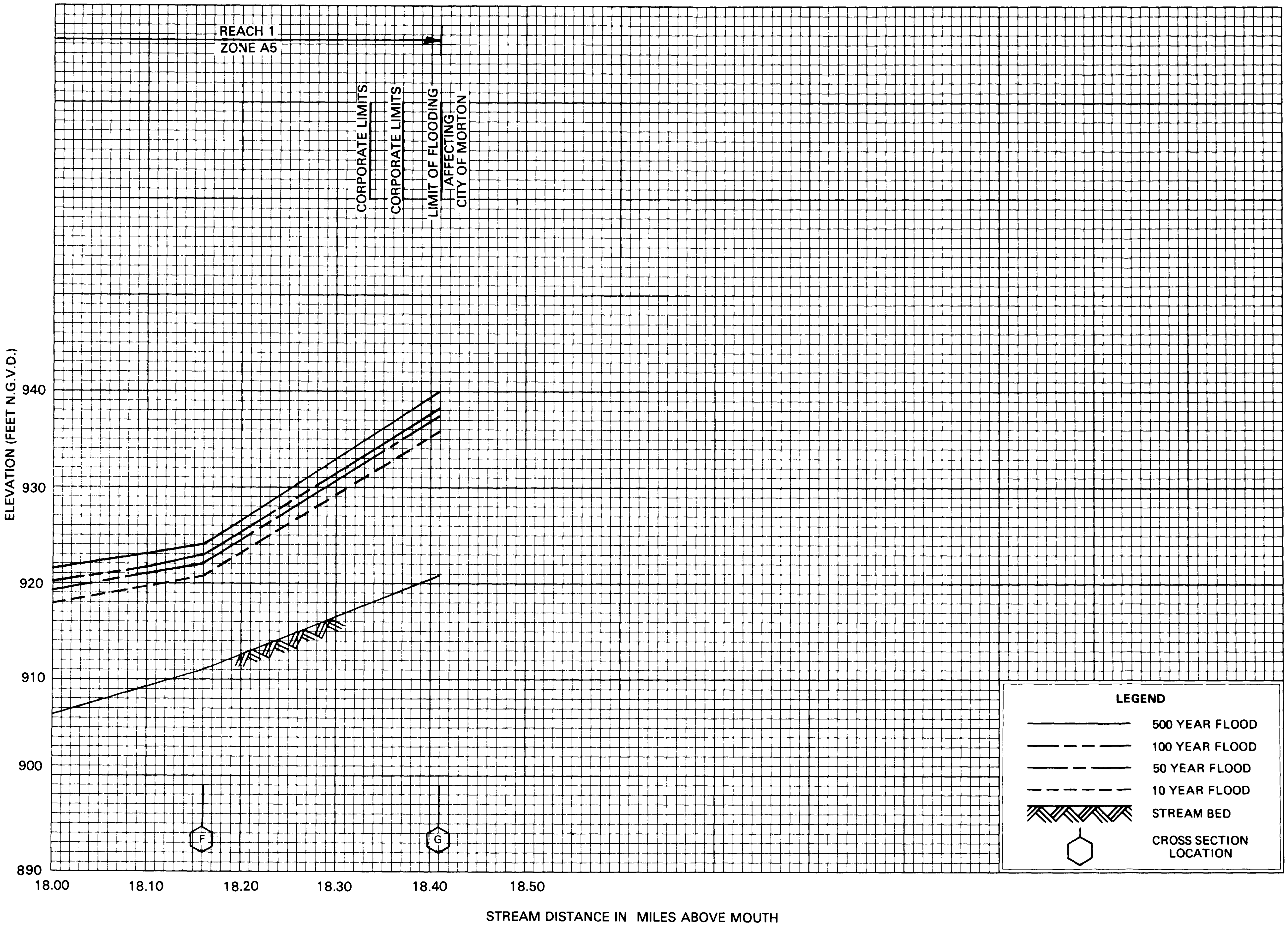

FLOOD PROFILES

TILTON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MORTON, WA
(LEWIS CO.)

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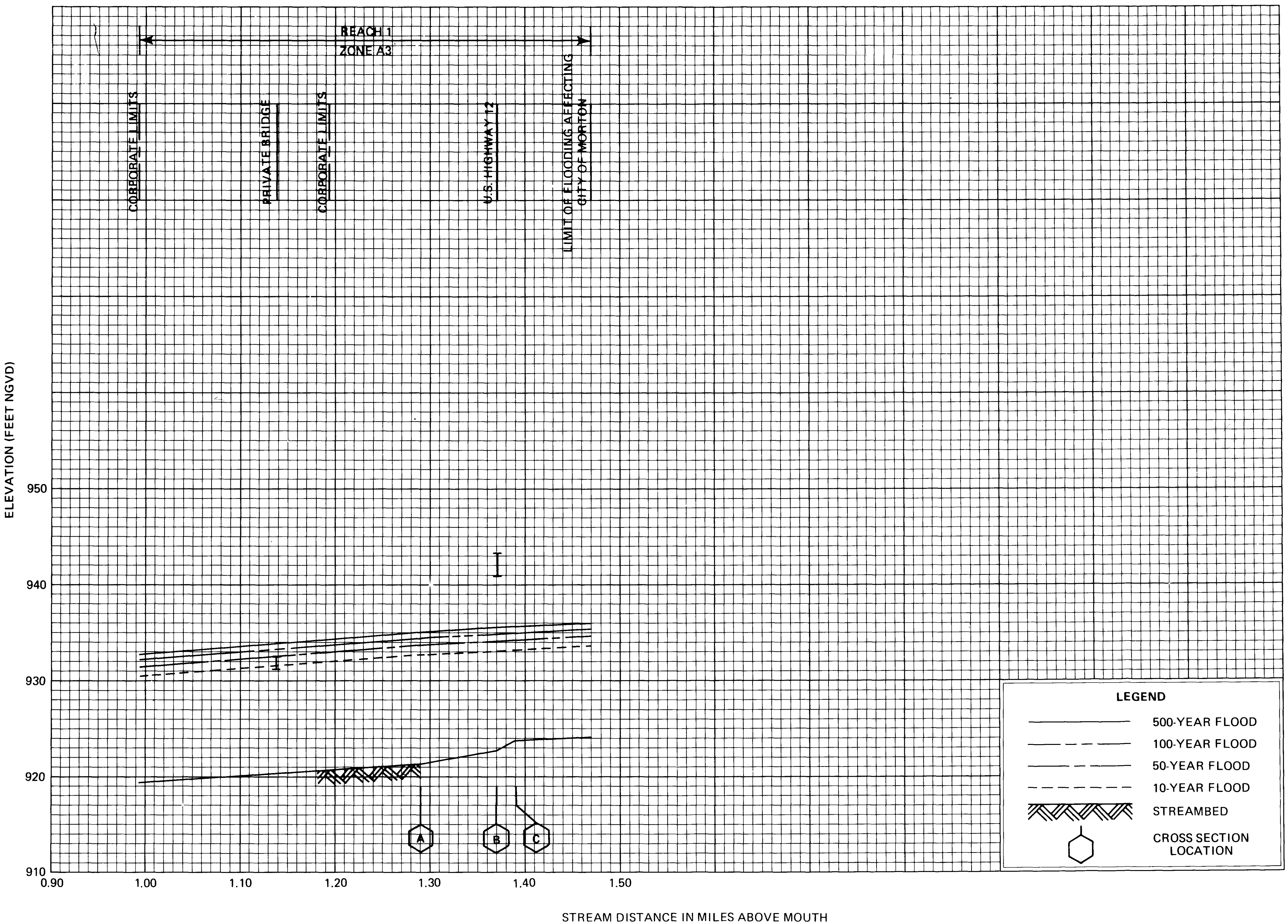

FLOOD PROFILES

LAKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MORTON, WA
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03P

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